Science Drivers for a Landsat Data Continuity Mission

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Major National Priorities

- Several national science priorities focus new emphasis on Land Use and Cover Change and the necessary observational systems.
- LUCC is a major agent of environmental change, linking many important issues.
- It is now clear that understanding land use effects on the environment will require more detailed spatially explicit information and models than those derivative of climate models.

Grand Challenges in Environmental Sciences

- NRC report to be released this year commissioned by the National Science Foundation :

  "Of the many scientific challenges related to the environment, which few offer the greatest potential for investment; that is, what are the grand challenges in environmental science?"

- NRC identified 8 Grand Challenges, 4 for immediate investments, Land Use Dynamic is one of these four.
- All 8 challenges call for more focus on spatial context and the need for obervsational tools at global and regional scales.

Scientific Readiness

- Scientific readiness for Land Use Dynamics is based on current remote sensing advances with Landsat, from the NRC report:

  "NASA's archiving of Landsat satellite images has enabled quantification of large-scale land use change"

  "Key organizaions and agencies are improving their databases on land in a manner consistent with the needs of global change science…The new Landsat 7 satellite will provide frequent worldwide imagery of land cover at costs affordable to the community of land reseachers"

  "Advances in imagery analysis and geographic information science are providing tools and analytical capacity to address land use/cover dynamics spatially and to link social science and biophysical data. These capabilities have triggered interest in land use among new communities of researchers such as demongraphers and economists."

Other areas of emerging research

- US Global Change Research Program is focusing a new program element on land use and cover change: land use/cover change is the *other* global change
- US Carbon Cycle research is focusing on land use change:

  "The growing appreciation of the role of past changes in land management for terrestrial sources and sinks of carbon should stimulate a rethinking of the terrestrial carbon cycle. (C.B. Field and I.Y Fung,1999. The not so big carbon sink, Science, *285(5427):544-545)*

- Internationally: Kyoto protocol, Global Obsvervations of Forest Cover, IGBP LUCC program.

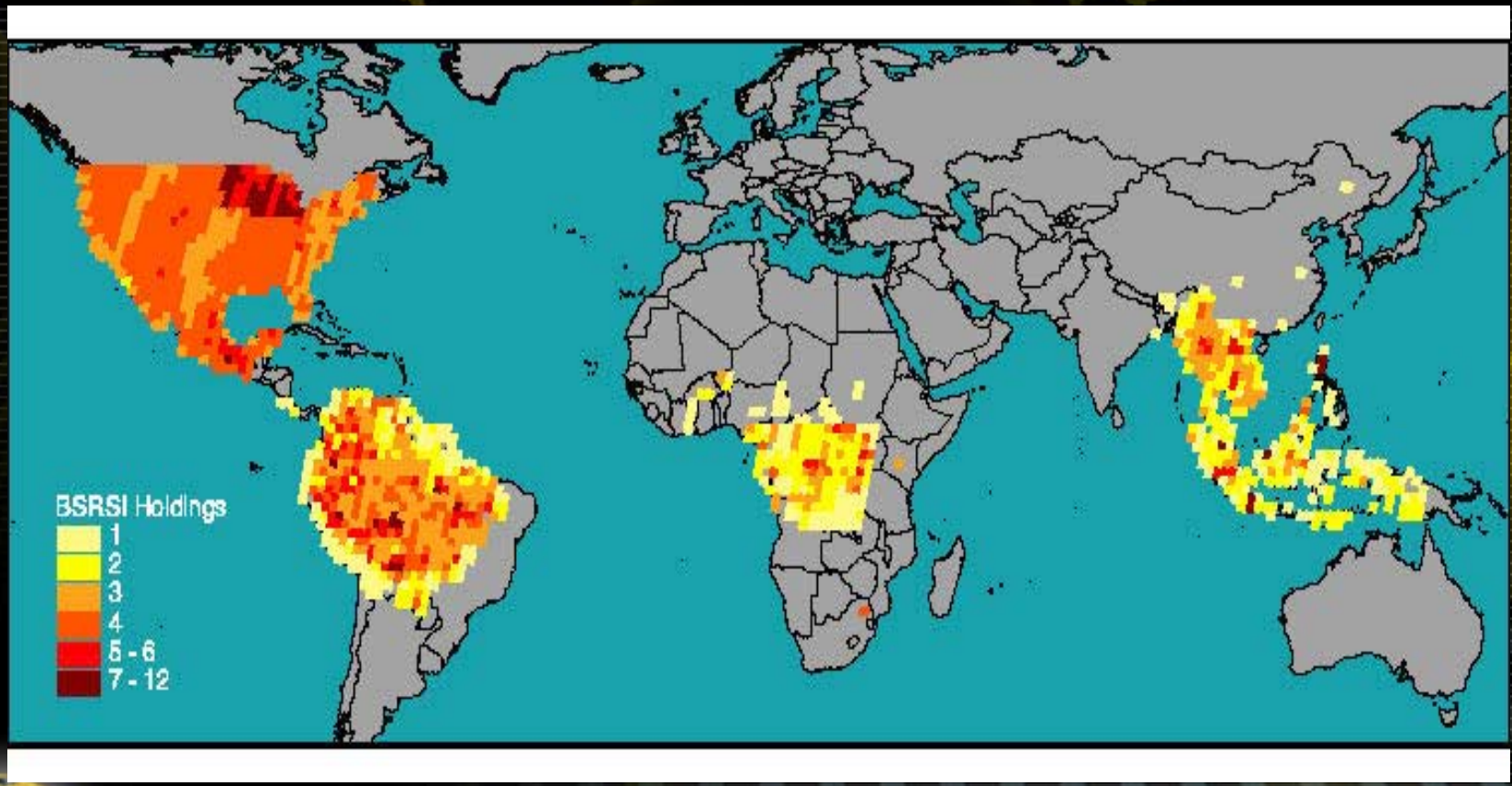
Changing the nature of global analysis

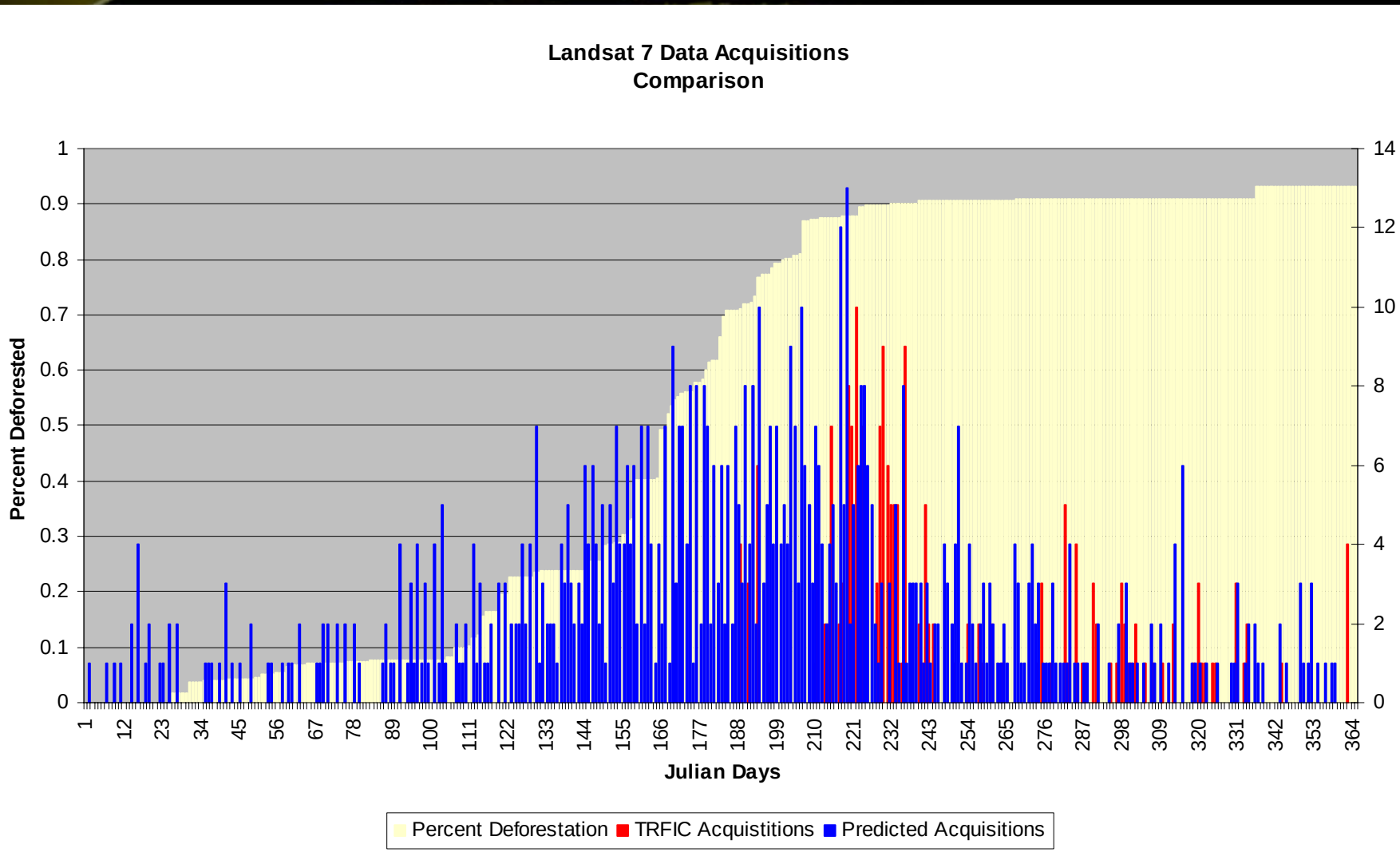
- Global carbon models have typically introduced land use change as a simple forcing function derivative of aggregated totals of area cleared on decadal time steps, with little consideration of spatiality.

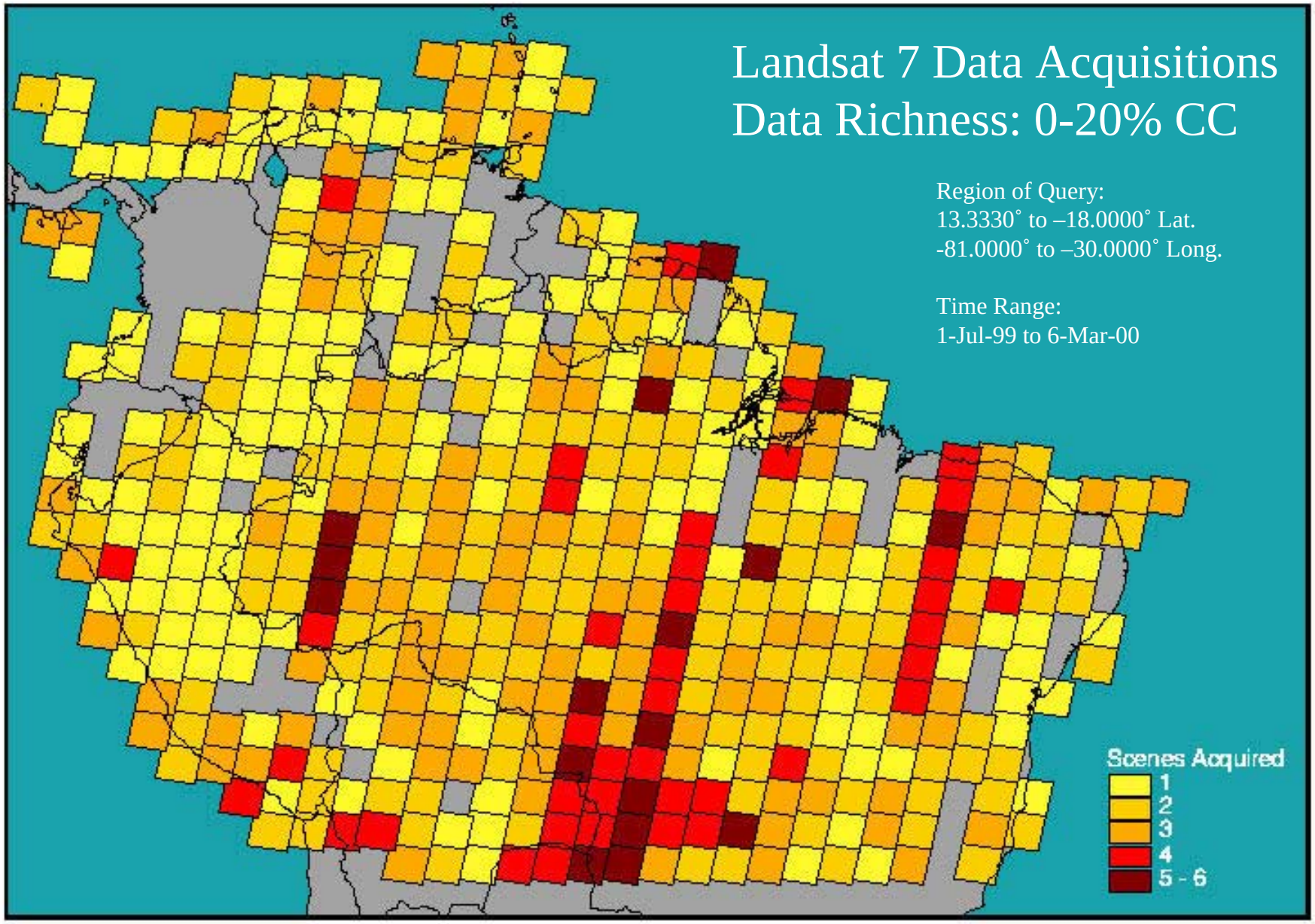
- Rarely is a high resolution spatially explicit map of land use change been used in carbon models, as might be derived from remote sensing.

- Now it is possible to use massive amounts of Landsat data to improve global monitoring and analysis.

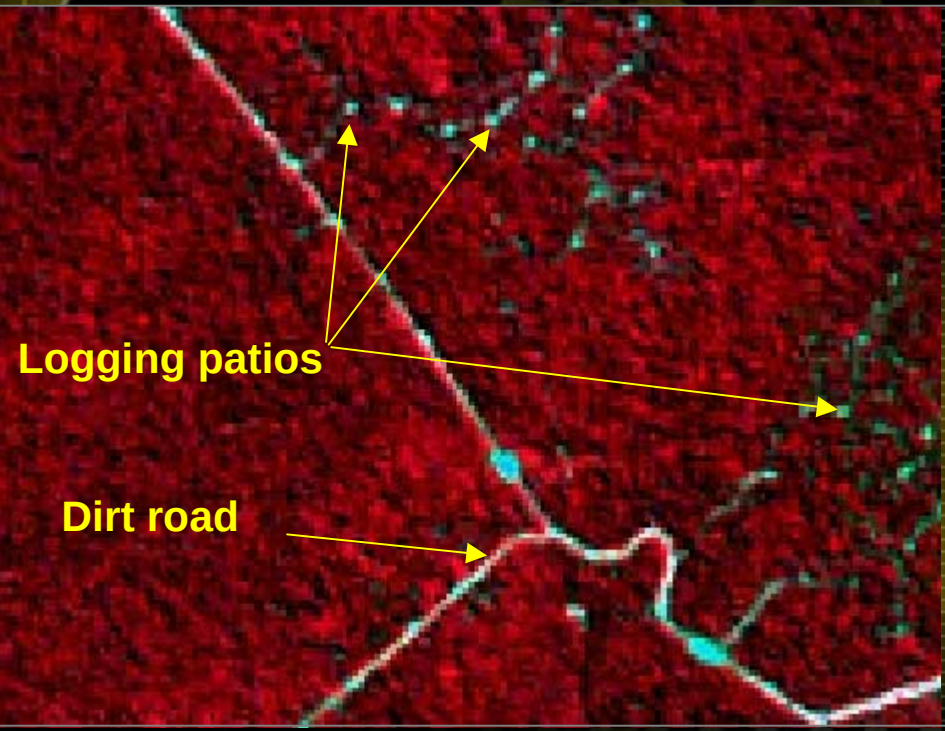
Global acquisition for carbon studies

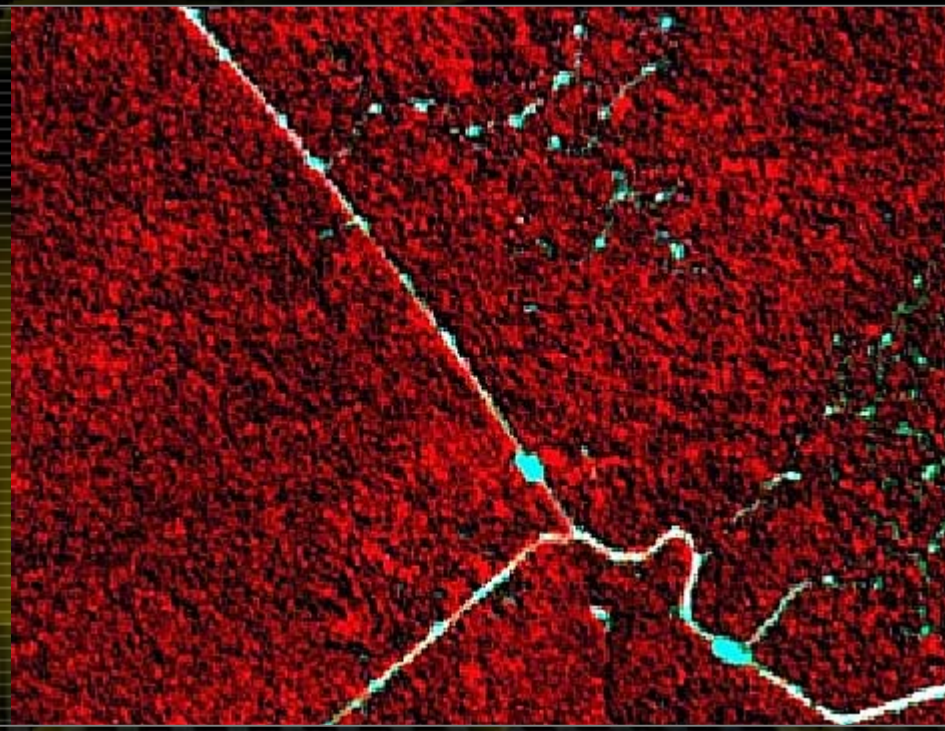



Landsat 7 Data Acquisitions
Comparison
Percent Deforested
Julian Days
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
14
12
10
8
6
4
2
0
1
12
23
34
45
56
67
78
89
100
111
122
133
144
155
166
177
188
199
210
221
232
243
254
265
276
287
298
309
320
331
342
353
364
Percent Deforestation
TRFIC Acquistitions
Predicted Acquisitions


Landsat 7 Data Acquisitions
Data Richness: 0-20% CC
Region of Query:
13.3330˚ to –18.0000˚ Lat.
-81.0000˚ to –30.0000˚ Long.
Time Range:
1-Jul-99 to 6-Mar-00
Scenes Acquired
1
2
3
4
5 - 6

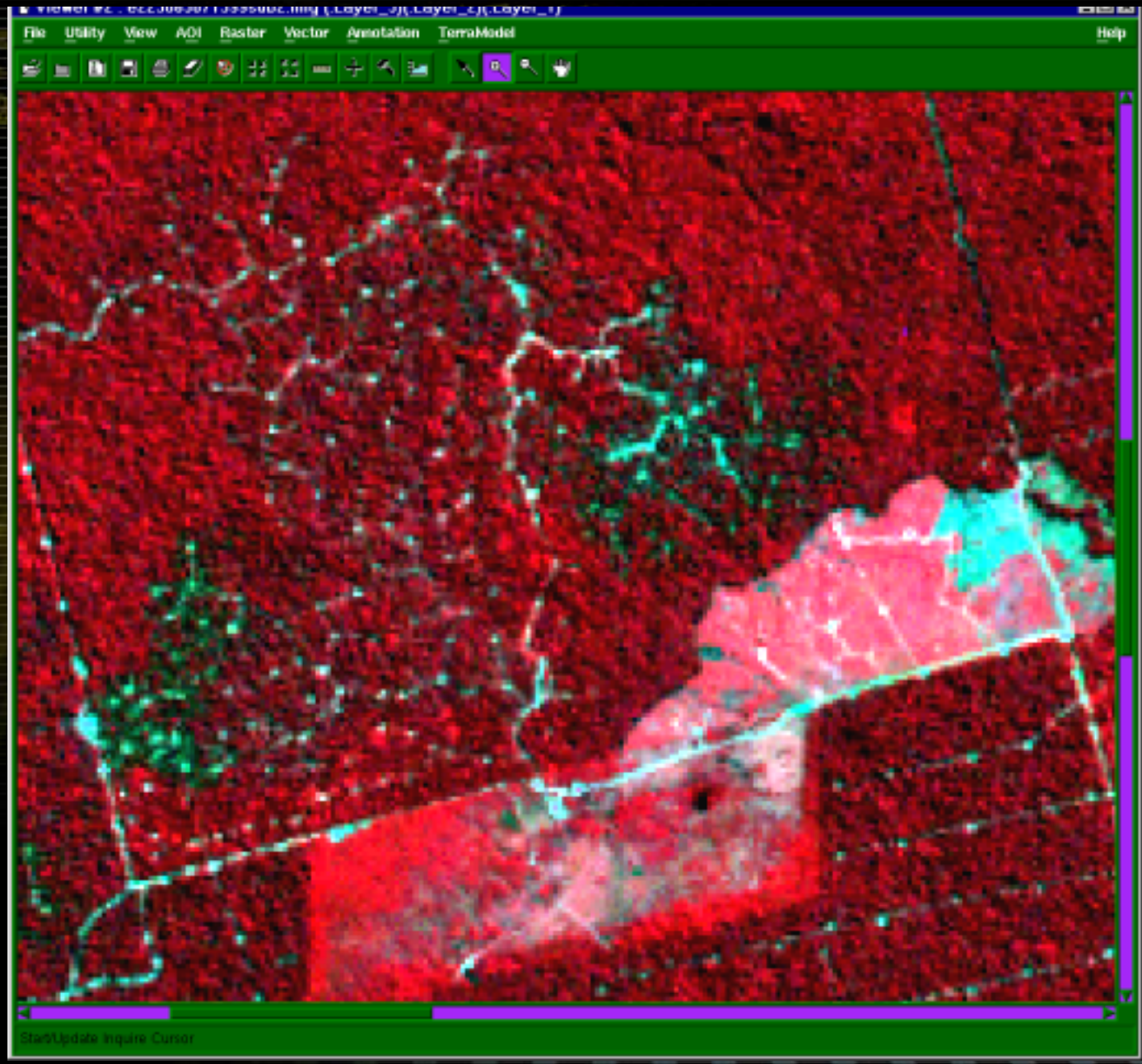
New Products for precision detection of degradation





ETM+ Multispectral

ETM+ With sharpening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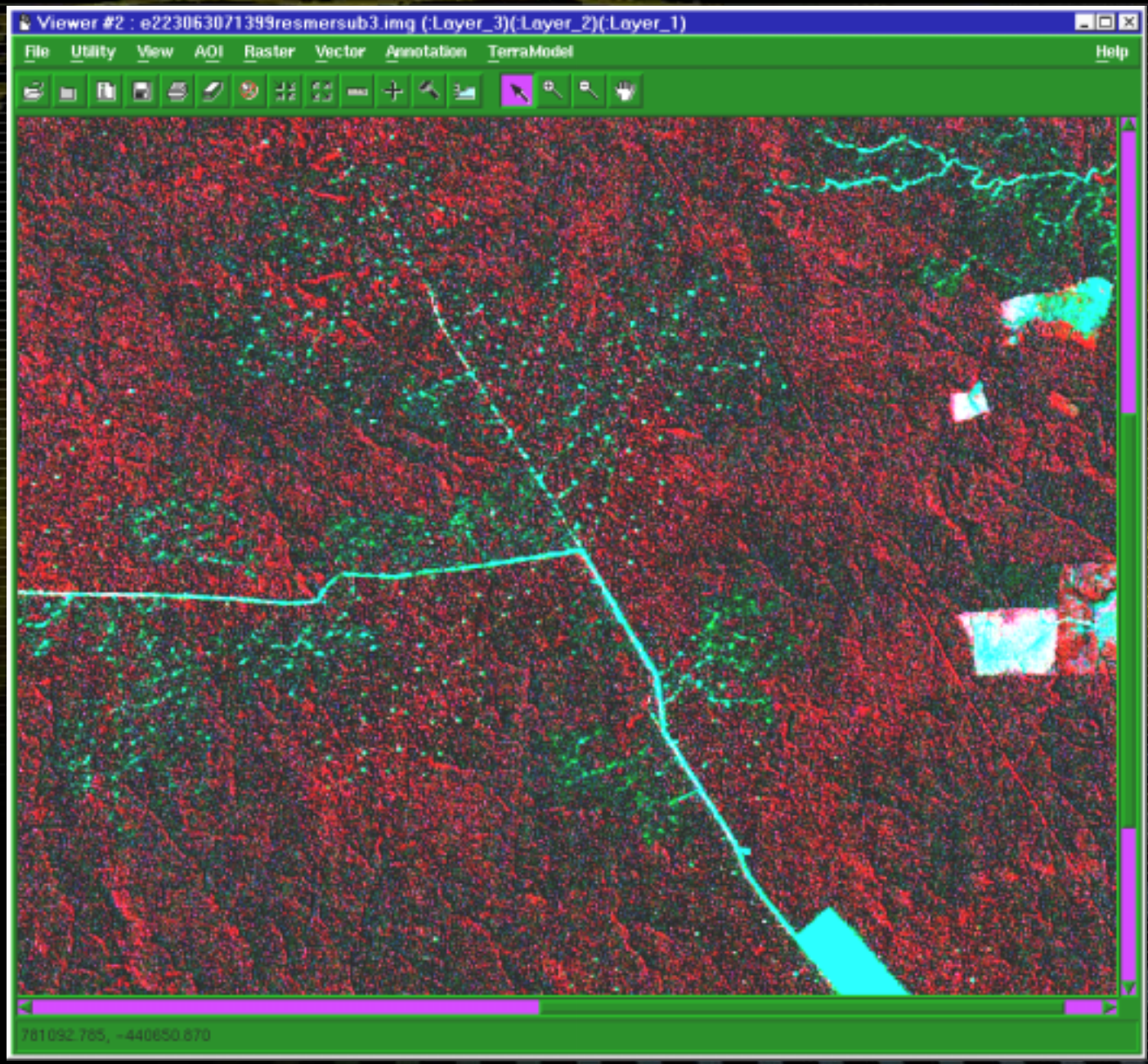
Utility
View
AOI
Raster
Vector
Annotation
TerraModel
Help
Start/Update Inquire Cursor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View
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Raster
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Annotation
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Help
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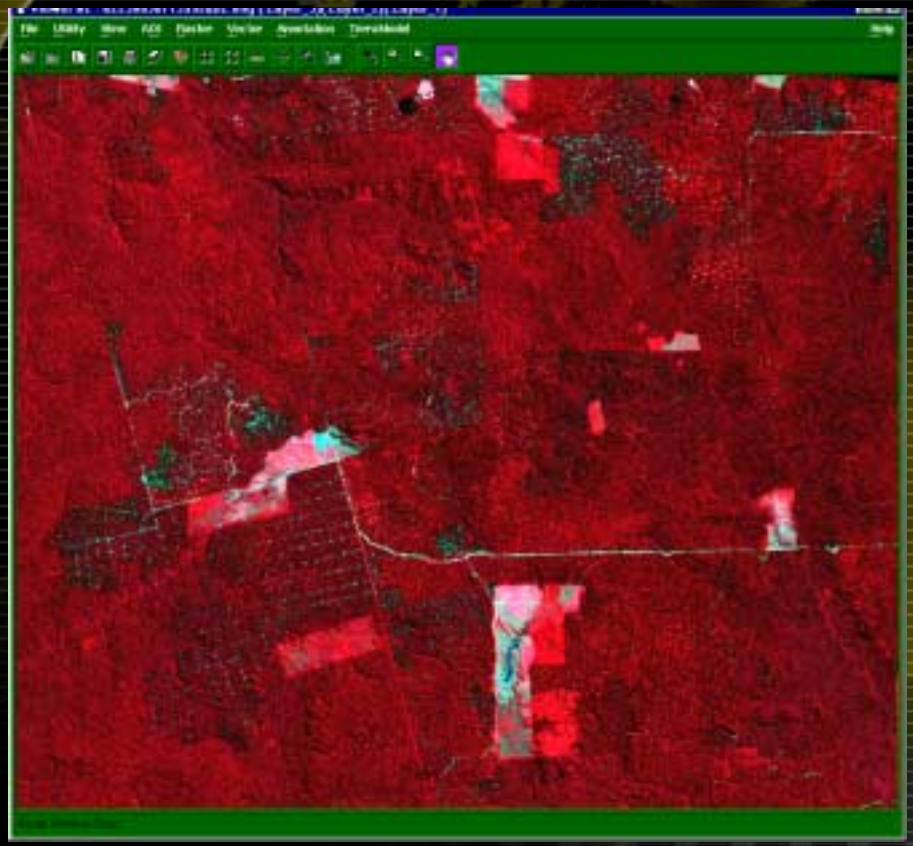
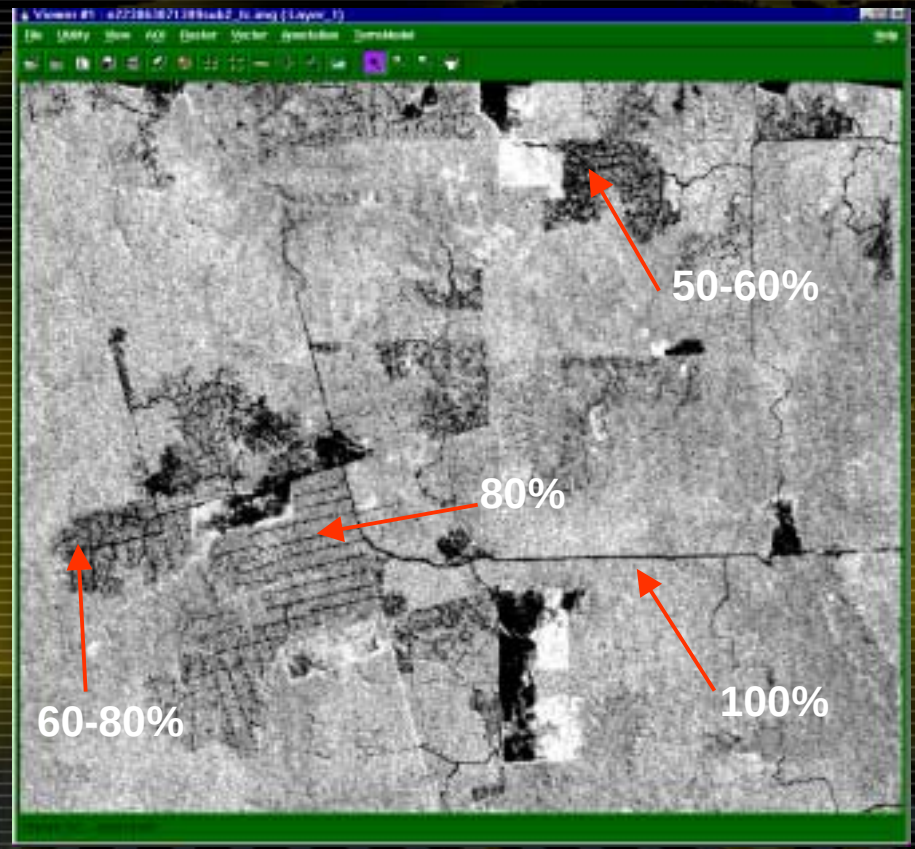
High resolution fractional cover assessment

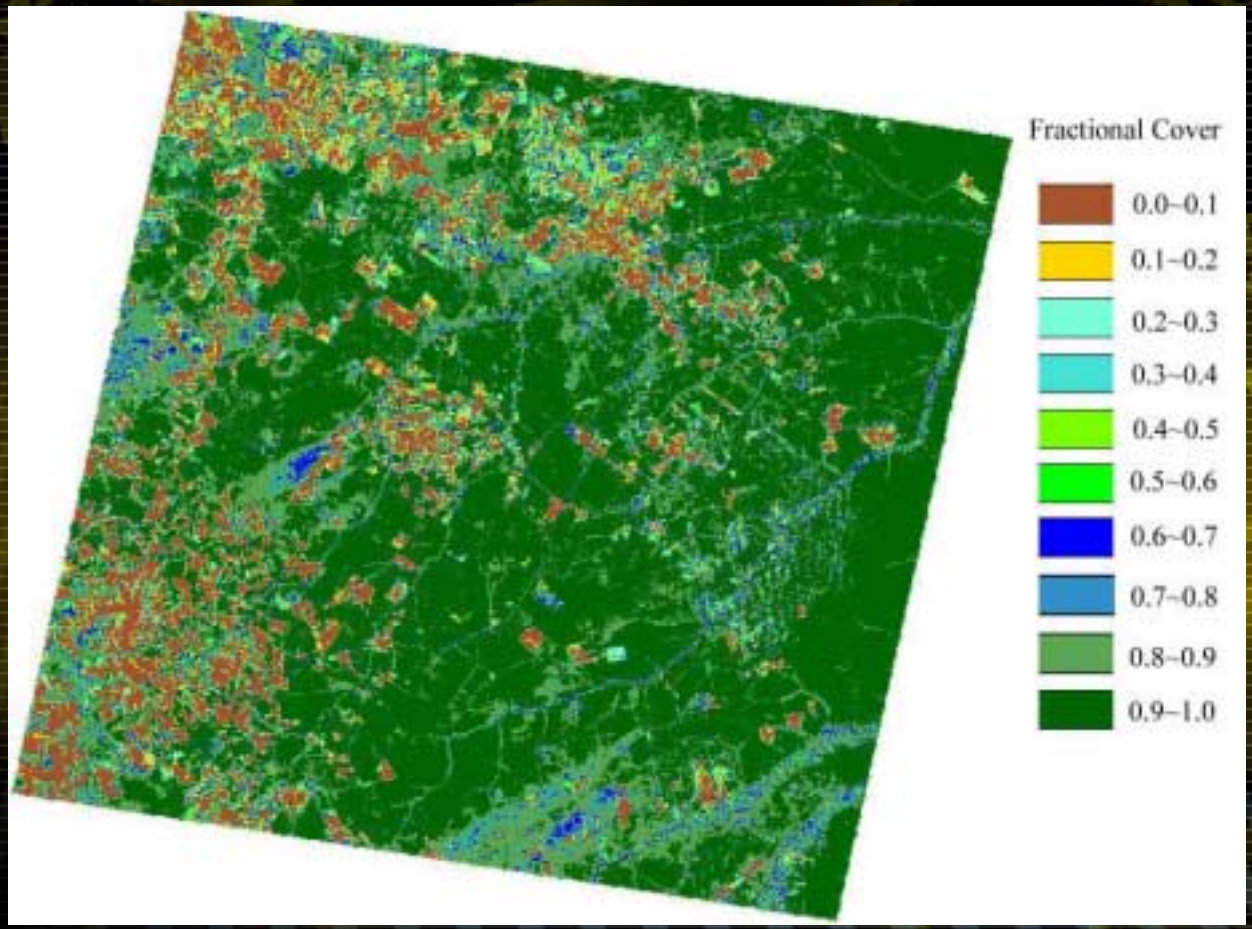


Site 2 – Color composite



Site 2 – Fractional Cover

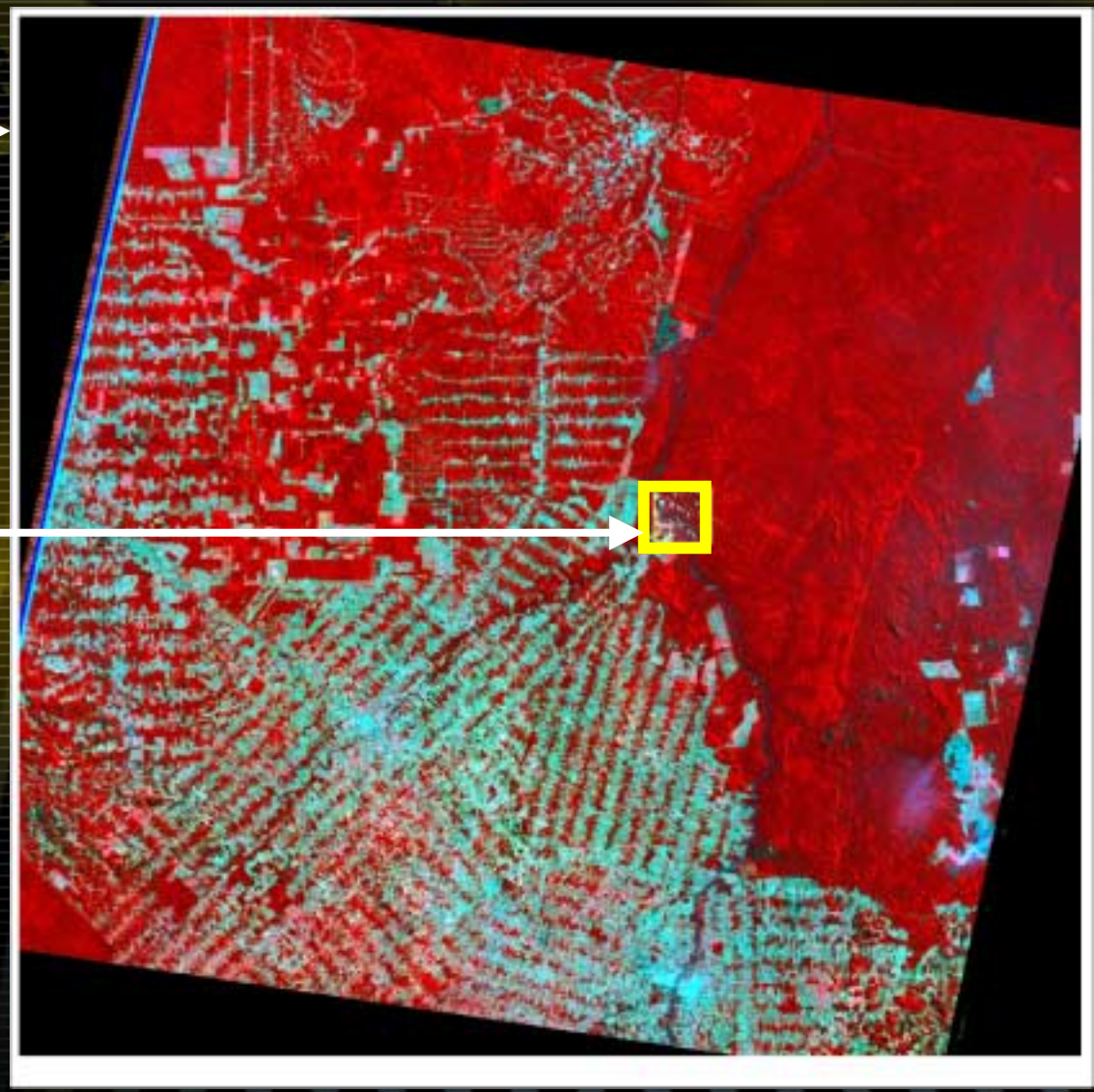
Fractional cover
Map product

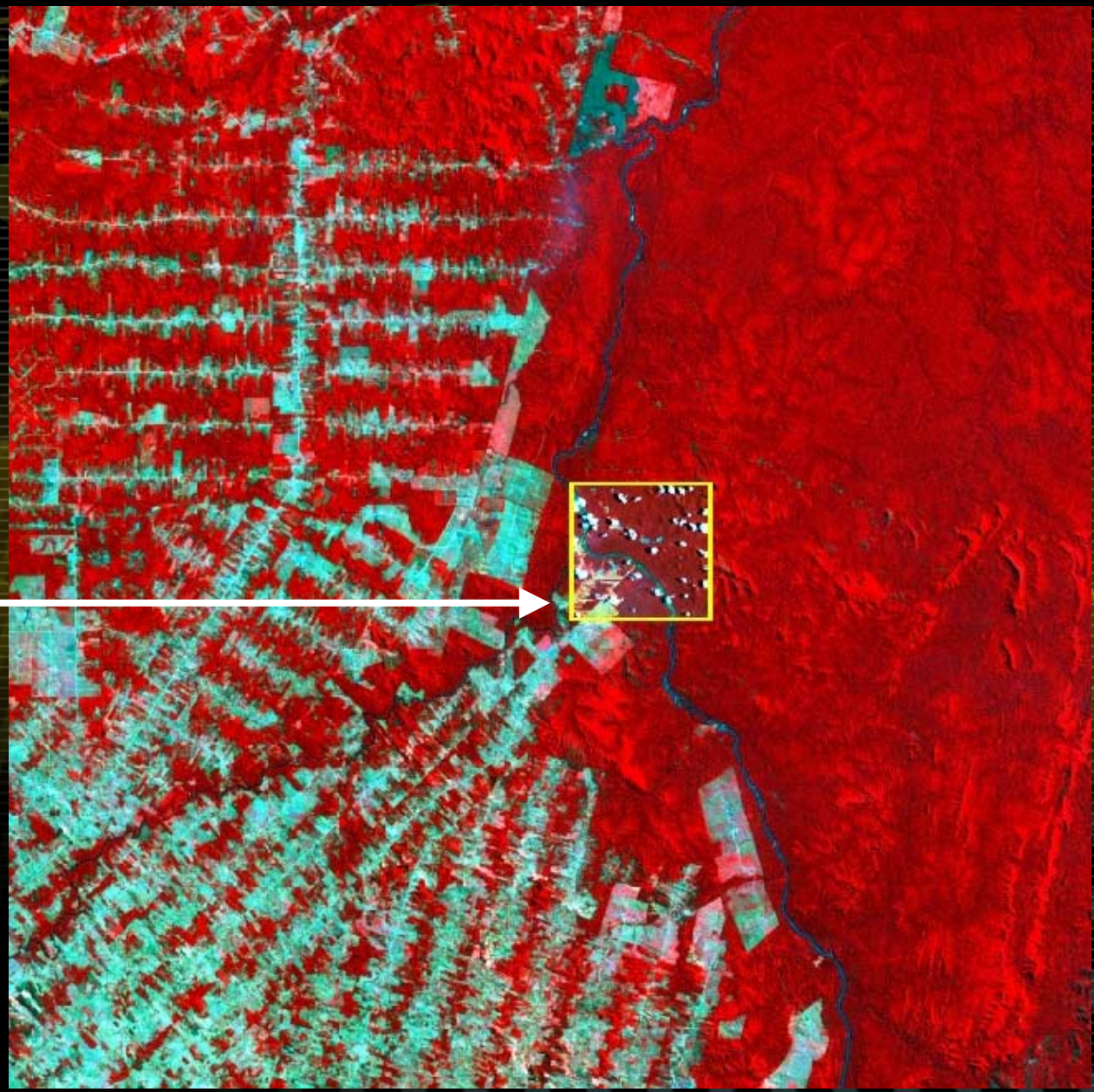


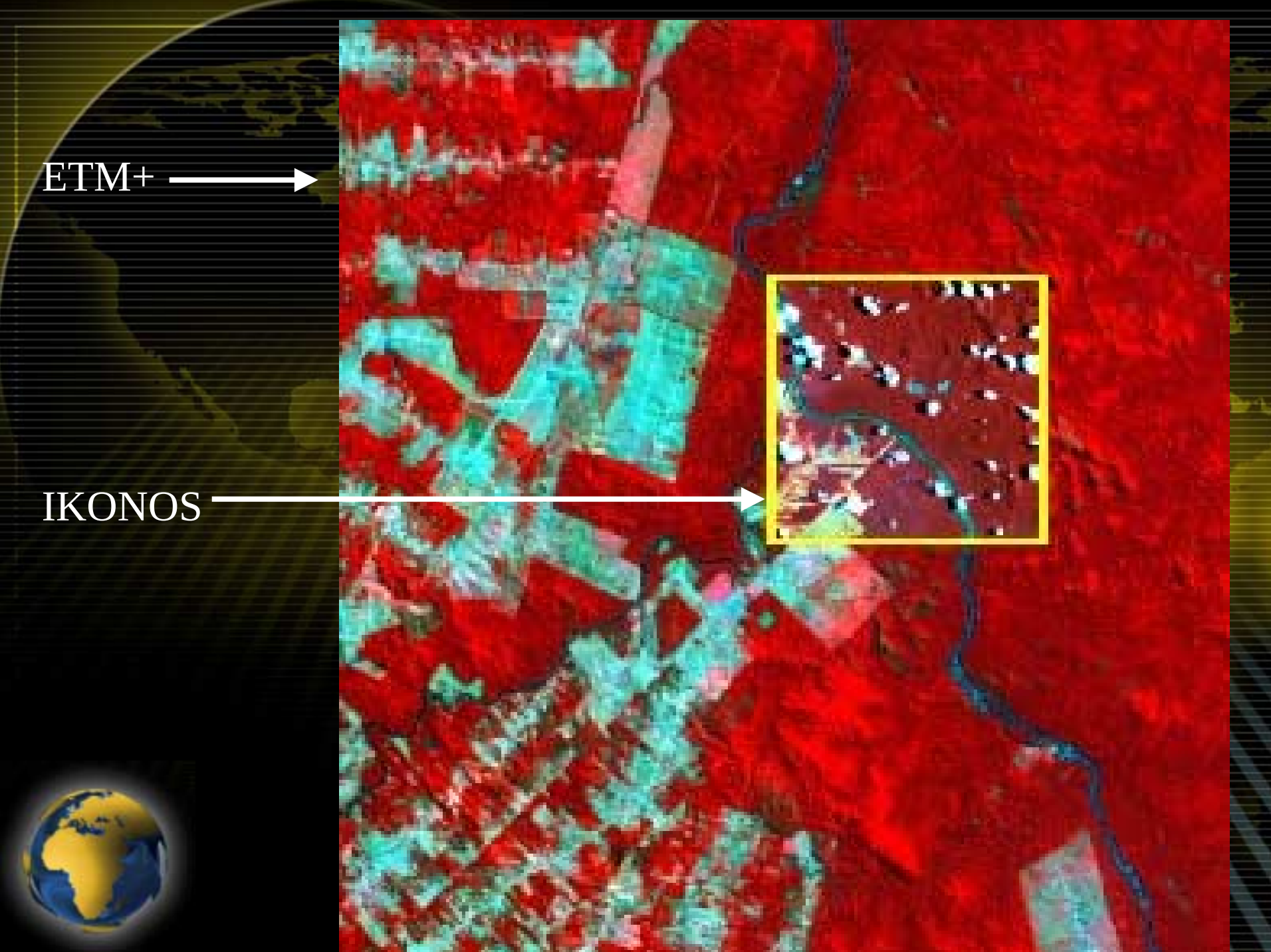
(Source: Qi et al. 2001)

ETM+

IKONOS

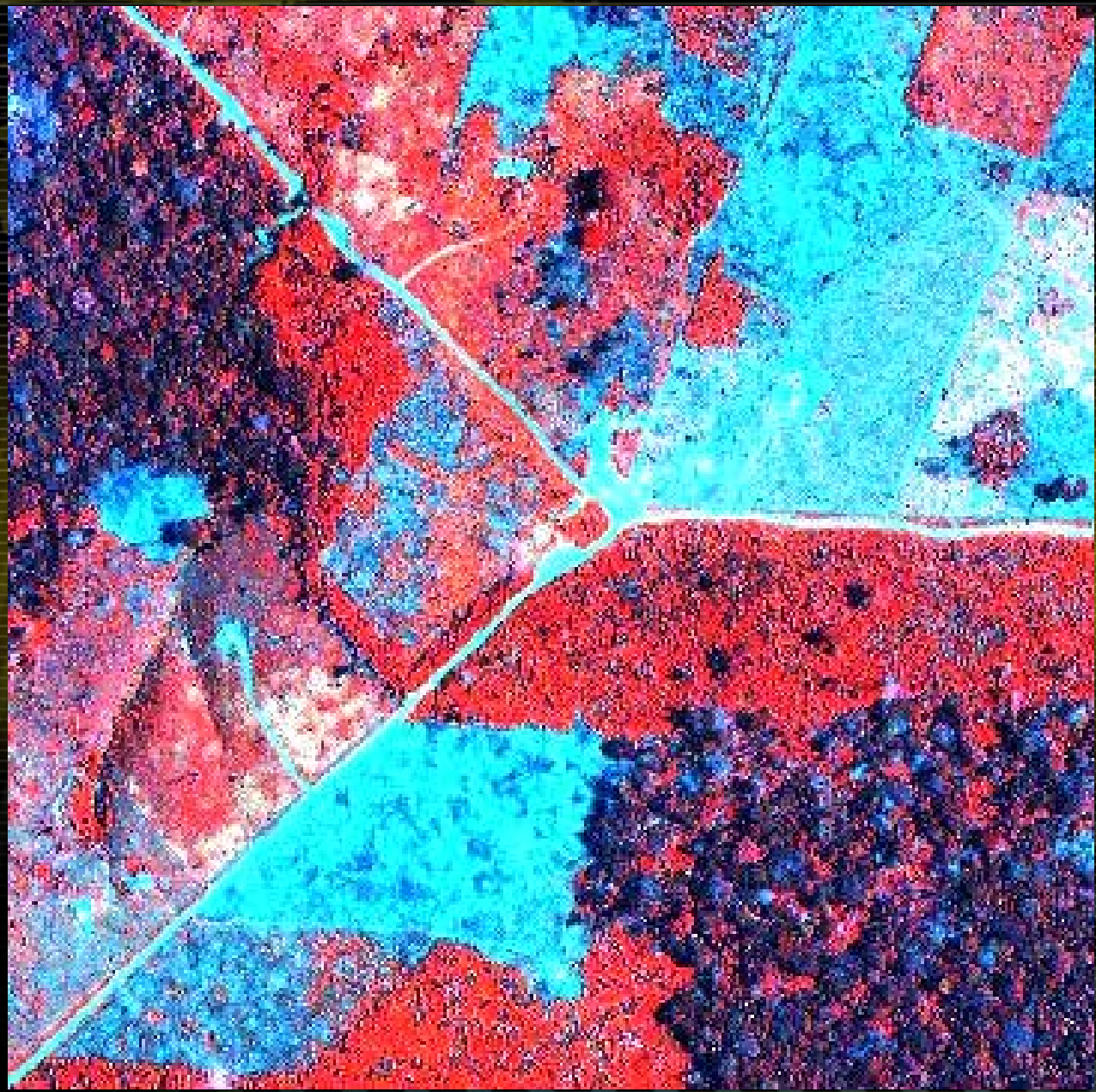



ETM+
IKONOS

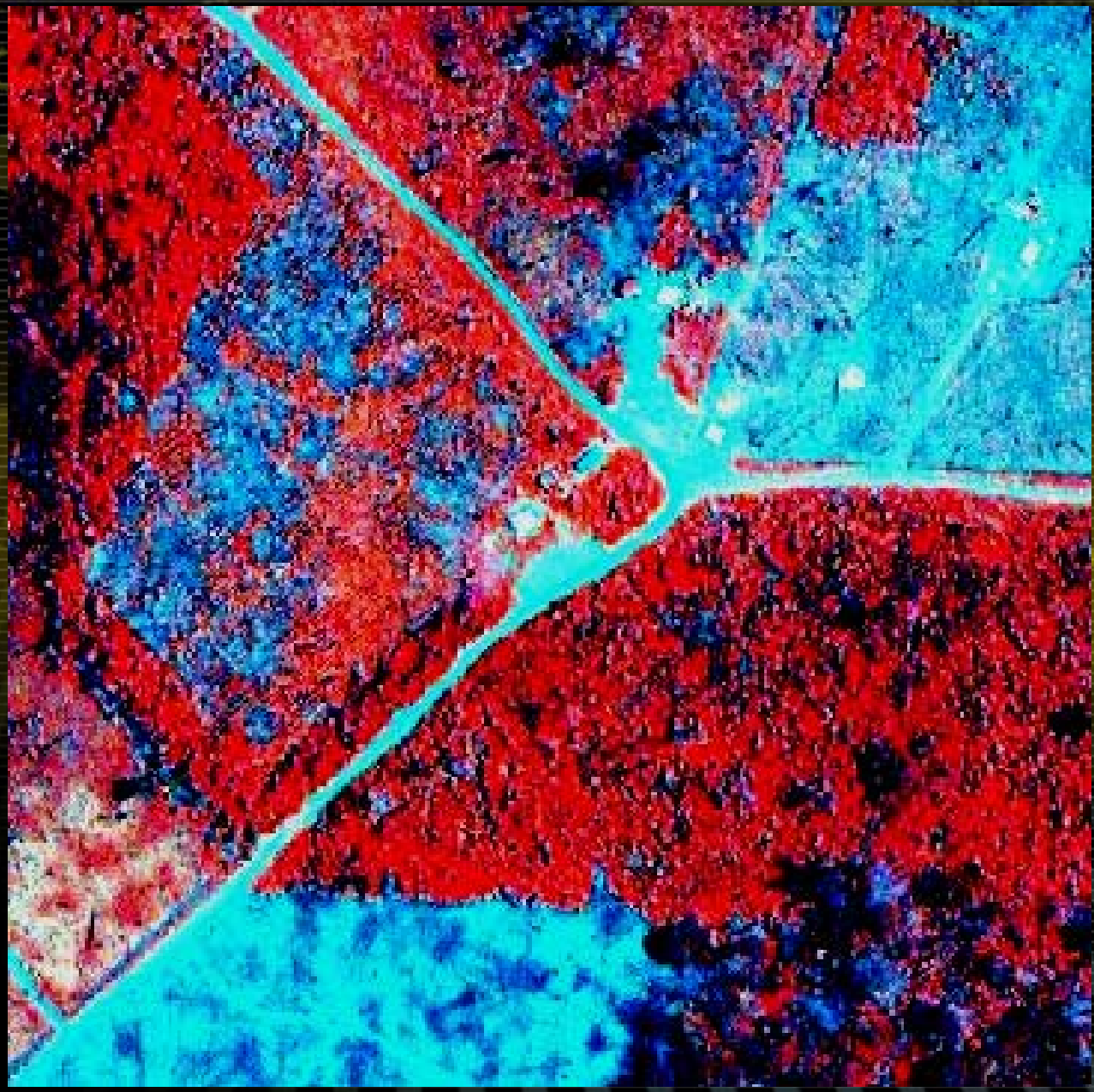

ETM+
IKONOS

IKONOS

acquisition



IKONOS
acquisition

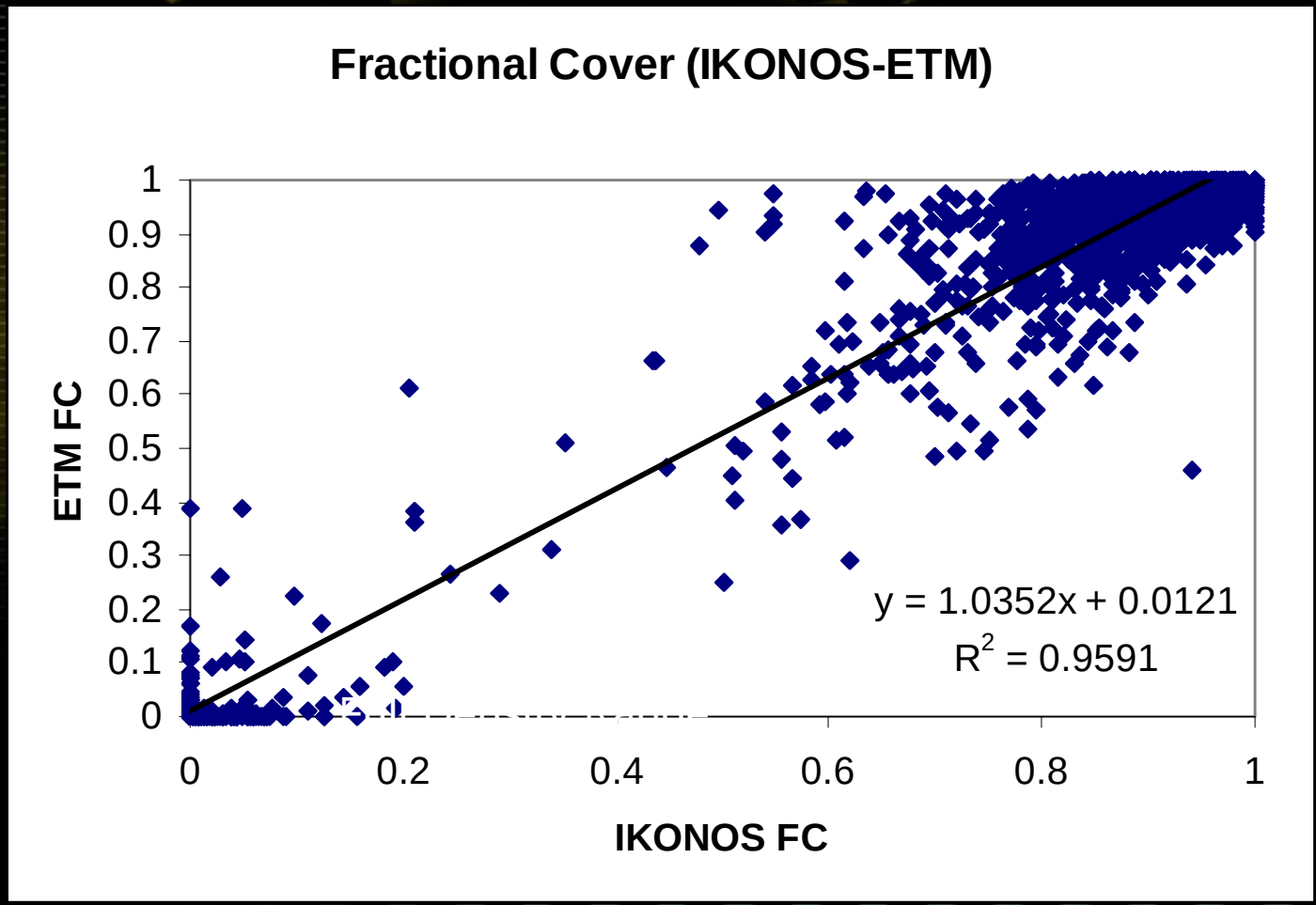


ETM+ Validation with Ikonos

IKONOS Pan-sharpened
(NIR+RED+Pan)

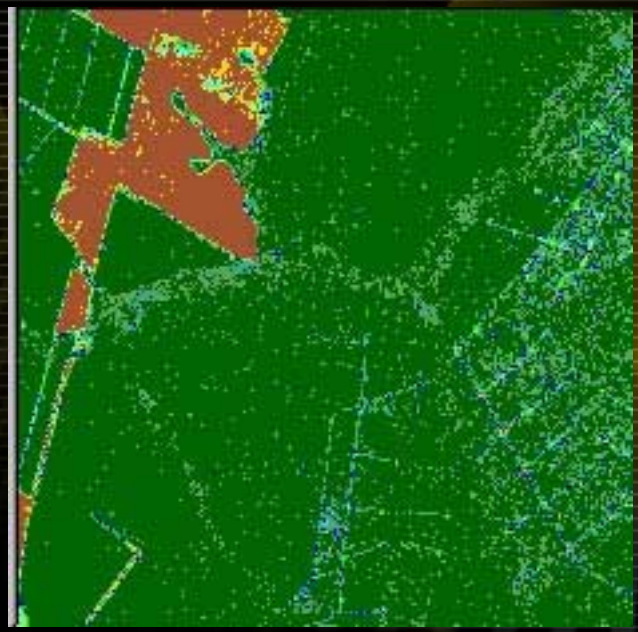
ETM+ Subset
(NIR+RED+GREEN)

Validation -- Statistical Analysis

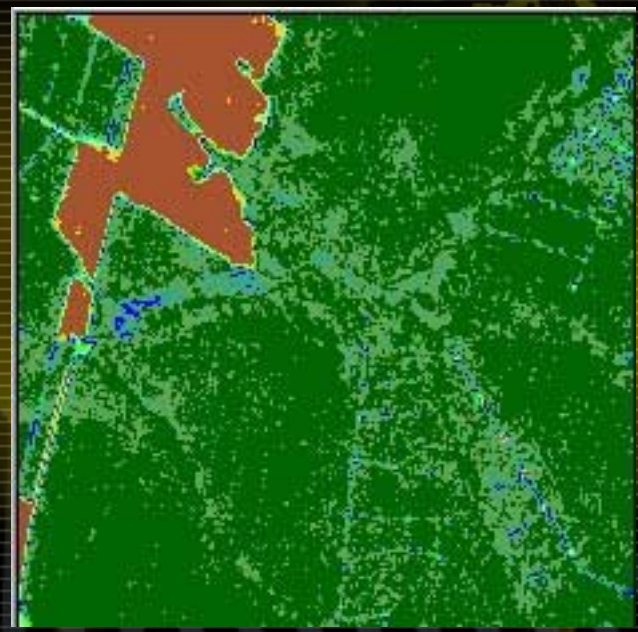


(Source: Qi et al. 2001)

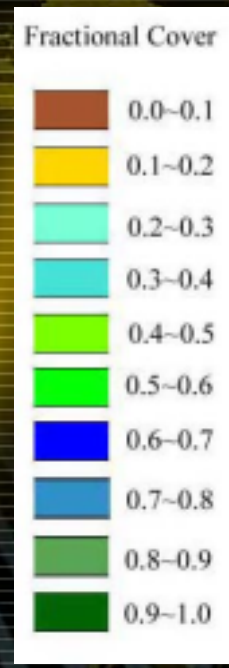
Validation of advanced products



IKONOS fc Map



ETM+ fc Map



(Source: Qi et al. 2001)

Science spin-offs to commercialization

- Science of the type mentioned – large scale Landsat class analysis of environmental change – can have important commercial spin offs
- Multi-agency national infrastructure for monitoring development in Amazonia
- Largest environmental project
- Landsat as the core monitoring instrument in an end-to-end information system design
- $1.5 B contract, 20,000 US based jobs, Green Technologies from commercialization of products from the science lab.